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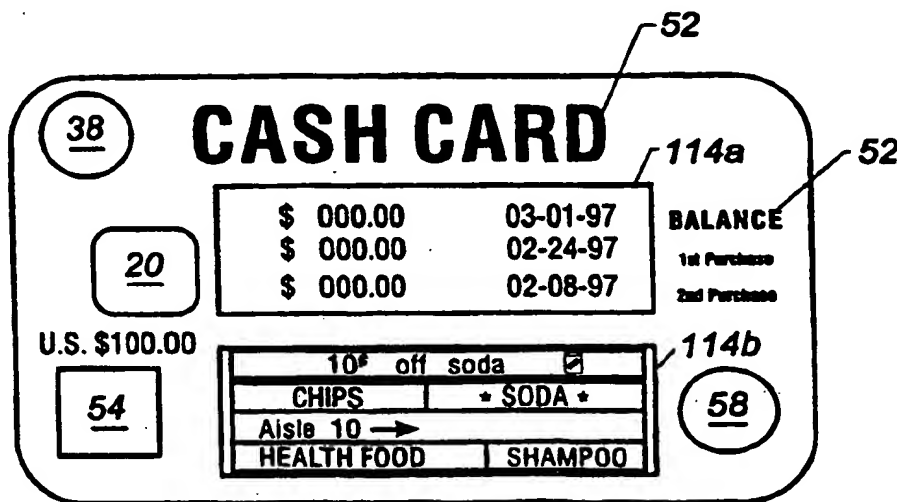
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<table style="width: 100%;"> <tr> <td style="width: 45%; vertical-align: top;"> <p>(21) International Application Number: <b>PCT/US99/01808</b></p> <p>(22) International Filing Date: <b>27 January 1999 (27.01.99)</b></p> <p>(30) Priority Data:</p> <table style="width: 100%;"> <tr> <td style="width: 30%;">09/014,055</td> <td style="width: 40%;">27 January 1998 (27.01.98)</td> <td style="width: 30%;">US</td> </tr> <tr> <td>09/040,517</td> <td>17 March 1998 (17.03.98)</td> <td>US</td> </tr> <tr> <td>09/061,879</td> <td>17 April 1998 (17.04.98)</td> <td>US</td> </tr> </table> <p>(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Applications</p> <table style="width: 100%;"> <tr> <td style="width: 30%;">US</td> <td style="width: 40%;">09/014,055 (CON)</td> <td style="width: 30%;"></td> </tr> <tr> <td>Filed on</td> <td>27 January 1998 (27.01.98)</td> <td></td> </tr> <tr> <td>US</td> <td>09/040,517 (CON)</td> <td></td> </tr> <tr> <td>Filed on</td> <td>17 March 1998 (17.03.98)</td> <td></td> </tr> <tr> <td>US</td> <td>09/061,879 (CON)</td> <td></td> </tr> <tr> <td>Filed on</td> <td>17 April 1998 (17.04.98)</td> <td></td> </tr> </table> <p>(71) Applicant (for all designated States except US): <b>VIZTEC INC.</b> [US/US]; Suite 200, 14502 North Dale Mabry, Tampa, FL 33618 (US).</p> <p>(72) Inventors; and</p> <p>(75) Inventors/Applicants (for US only): <b>FREEMAN, Gary, A.</b> [US/US]; 47 Stearns Street, Newton, MA 02159 (US).</p> </td> <td style="width: 55%; vertical-align: top;"> <p><b>FREEMAN, David, H. [US/US]; 13318 Golf Crest Circle, Tampa, FL 33624 (US).</b></p> <p>(74) Agent: <b>LEE, G., Roger, Fish &amp; Richardson P.C., 225 Franklin Street, Boston, MA 02110-2804 (US).</b></p> <p>(81) Designated States: <b>AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</b></p> <p><b>Published</b> <i>With international search report.</i></p> </td> </tr> </table>			<p>(21) International Application Number: <b>PCT/US99/01808</b></p> <p>(22) International Filing Date: <b>27 January 1999 (27.01.99)</b></p> <p>(30) Priority Data:</p> <table style="width: 100%;"> <tr> <td style="width: 30%;">09/014,055</td> <td style="width: 40%;">27 January 1998 (27.01.98)</td> <td style="width: 30%;">US</td> </tr> <tr> <td>09/040,517</td> <td>17 March 1998 (17.03.98)</td> <td>US</td> </tr> <tr> <td>09/061,879</td> <td>17 April 1998 (17.04.98)</td> <td>US</td> </tr> </table> <p>(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Applications</p> <table style="width: 100%;"> <tr> <td style="width: 30%;">US</td> <td style="width: 40%;">09/014,055 (CON)</td> <td style="width: 30%;"></td> </tr> <tr> <td>Filed on</td> <td>27 January 1998 (27.01.98)</td> <td></td> </tr> <tr> <td>US</td> <td>09/040,517 (CON)</td> <td></td> </tr> <tr> <td>Filed on</td> <td>17 March 1998 (17.03.98)</td> <td></td> </tr> <tr> <td>US</td> <td>09/061,879 (CON)</td> <td></td> </tr> <tr> <td>Filed on</td> <td>17 April 1998 (17.04.98)</td> <td></td> </tr> </table> <p>(71) Applicant (for all designated States except US): <b>VIZTEC INC.</b> [US/US]; Suite 200, 14502 North Dale Mabry, Tampa, FL 33618 (US).</p> <p>(72) Inventors; and</p> <p>(75) Inventors/Applicants (for US only): <b>FREEMAN, Gary, A.</b> [US/US]; 47 Stearns Street, Newton, MA 02159 (US).</p>	09/014,055	27 January 1998 (27.01.98)	US	09/040,517	17 March 1998 (17.03.98)	US	09/061,879	17 April 1998 (17.04.98)	US	US	09/014,055 (CON)		Filed on	27 January 1998 (27.01.98)		US	09/040,517 (CON)		Filed on	17 March 1998 (17.03.98)		US	09/061,879 (CON)		Filed on	17 April 1998 (17.04.98)		<p><b>FREEMAN, David, H. [US/US]; 13318 Golf Crest Circle, Tampa, FL 33624 (US).</b></p> <p>(74) Agent: <b>LEE, G., Roger, Fish &amp; Richardson P.C., 225 Franklin Street, Boston, MA 02110-2804 (US).</b></p> <p>(81) Designated States: <b>AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</b></p> <p><b>Published</b> <i>With international search report.</i></p>
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(54) Title: **TRANSMITTING ADVERTISEMENTS TO SMART CARDS**

**100** →



**(57) Abstract**

A flexible chip card (100) has a flexible display (114a), and a power source (38), is used in a system which transmits various information for storage and later retrieval. The liquid crystal display (114a) may be of the bistable type, requiring no power to continuously display an image. The display may include a barrier strip to provide stereoscopic effects. The chip card (100) may be used to store coupons, advertisements, tickets, Internet addresses, images, audio data, and other information.

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## TRANSMITTING ADVERTISEMENTS TO SMART CARDS

### Background of the Invention

The present invention relates to data or  
5 transaction cards containing semiconductor processors  
and/or memory chips.

Such cards are commonly referred to as chip cards  
(or smart cards). They are typically wallet-size and  
contain a microchip. Often, there are electrical  
10 contacts on the surface of the card through which  
communications are made between an external chip card  
device and the semiconductor chip, but there are also  
wireless chip cards in which communication is made using  
a wireless transceiver located within the card. Chip  
15 cards are now being used in numerous applications,  
including telecommunications, government benefits  
programs, health care, public transportation,  
universities, and vending machines.

One of the widespread uses of chip cards today is  
20 as a stored-value card which contains monetary value in  
the microchip embedded in the card. For example, each  
time a consumer uses a chip card in a vending machine,  
the amount of the purchase is deducted from the cash  
balance stored in the microchip on the card. One  
25 application for such stored-value cards is eliminating  
the need for people to carry around small coins or bills  
and speeding up the time it takes to consummate small  
cash transactions. However, current chip cards offer no  
built-in mechanism for viewing the cash balance remaining  
30 on the chip card. This reduces the convenience and ease  
of use of chip cards.

Initially, a consumer could only determine the  
cash balance on a chip card by taking the card to a  
vending machine, retail location, or other point of  
35 purchase equipped with a chip card reader. Several

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portable chip card readers were developed to provide chip card users with a convenient way to determine the cash balance on their chip cards.

Although these portable chip card reading devices, including the ones shown in U.S. Pat. No. 5,015,830 to Masuzawa and U.S. Pat. No. 5,517,011 to Vandenengel, make chip cards more convenient to use than without such devices, these chip card readers still suffer from numerous disadvantages. For example, some require battery replacement at regular intervals; some portable card readers are sealed units in which the batteries cannot be replaced, thus requiring the consumer to purchase a new card reader every time the batteries wear out. Many chip cards require their own specially programmed card reader; if a consumer has several types of chip cards in his or her wallet, they could also require several different chip card readers in their wallet, which would be bulky, inconvenient, and very impractical to use. Current chip card readers are inconvenient to use, as they either require the consumer to insert the chip card into the reader each time the consumer wants to check the balance, or the consumer must keep the chip card in the reader at all times, press a button to check the balance, and then remove the card from the reader in order to consummate a transaction. They require the consumer to carry a separate device, which can easily be lost or forgotten, leaving the consumer without any way to spontaneously determine the cash balance on the chip card. They are costly devices in relation to the total cost of manufacturing a chip card. It is easy to forget the cash balance on the chip card, which requires the consumer to frequently recheck the balance using the portable balance reader.

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Displays have been suggested for data cards. U.S. Patent No. 4,954,985 to Yamazaki discloses a card with a ferroelectric liquid crystal memory region and a ferroelectric liquid crystal display region. U.S. Patent 5 No. 4,746,787 to Suto discloses an IC Card with a display and an integrated circuit containing a processor and memory. Neither patent suggests a flexible display element or flexible card body. Yamazaki refers to using both Corning 7059 glass or plastic for the card body, 10 without any indication that one is preferable to the other. Suto suggests plastic for the card substrate but the disclosed liquid crystal display would fracture if the card underwent flexing of the type and magnitude experienced by a card during normal use, handling, and 15 storage (e.g., storage in a pocket, wallet, or purse).

In the case of chip cards used in applications other than stored-value, such as health care, currently available chip cards require the user to go to a location with a chip card reader in order to display information 20 contained in the microchip on the card. If a health care chip card holder has a serious medical condition and is taking medication for that condition, an emergency caregiver must have access to a chip card reader to find out what medication the patient is taking or what medical 25 condition the person has that could be critical in deciding what emergency treatment to give the patient. Today, many chip cards contain information that would be very valuable if it could be instantly accessed, but which loses its value once the card user has to search 30 and take the time to find a chip card reader in order to access the information.

Chip card systems divide broadly into open or closed systems. Closed systems limit chip card usage to particular chip card readers. For example, a long- 35 distance carrier may offer chip cards that only operate

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their long-distance equipment. Open systems (e.g., VisaCash) operate on a wider variety of chip card readers.

Often chip cards include advertisements permanently printed on their body. For example, a long distance calling card may feature a printed image of the long distance carrier's trademark.

#### Summary of the Invention

The invention provides a chip card with a practical, built-in display. The card can undergo flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse) without permanent damage to the display element or permanent loss of the displayed information.

In general, the invention features a chip card including a flexible body; at least one semiconductor chip supported within the flexible body and comprising a memory for storing the information; a display element capable of displaying at least a portion of the information stored in the semiconductor chip, the display element being supported within the flexible body and comprising display areas viewable from at least one side of the chip card; circuitry for controlling the display element; the chip card being capable of undergoing flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse) without permanent damage to the display element and without permanent loss of the displayed information.

One or more of the following features may be incorporated into embodiments of the invention: the display element, itself, can be made tolerant of such flexing, or the display can be located in an area of the chip card that does not undergo substantial flexing (e.g., a corner).

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The display element may have the capability to continue displaying information after electrical power is removed from it. The display element may offer a multi-color display. The display element may offer stereoscopic effects, for example, by layering a barrier strip over the display element. Additionally, the card may feature multiple displays.

Contacts exposed on a surface of the card can be provided for establishing communication with the semiconductor chip. Alternatively, a wireless communication element can be provided within the card.

Internal connection elements may be provided for connecting the semiconductor chip to the display element. The internal connection elements are preferably configured to withstand flexing.

The flexible body may be constructed from various materials, including plastic, paper, reinforced paper, and cardboard. If from plastic, the material may include polyvinyl chloride, polyester, ABS, or polycarbonate.

A substantially transparent layer of protective plastic may be provided to cover the display areas of the display element.

An additional information storage medium (e.g., bar code symbol, magnetic stripe element) may be provided in addition to the semiconductor chip.

The card may include a power source. The power source may be replaceable and/or rechargeable. The card may provide a mechanism to conserve power (e.g., a kickstart circuit). The power source may provide multimedia features. For example, the power source may drive a speaker, a microphone, or cause the display element to produce a series of images (e.g., a video clip) on the display element. The power supply may also power communication elements in a contactless card.

The invention has numerous advantages. It avoids the need for external readers by providing a practical

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built-in display of information stored on a card that can undergo flexing. This allows users of the cards to carry and handle the cards as they would conventional chip cards lacking a display. When applied to stored value cards, the invention permits the user of a card to conveniently determine the cash balance with as little as a quick glance at the face of the card, similar to coins or paper money which have their value printed on their face. The display element can provide a display of information without the use of batteries or any other power source, thus reducing the long term costs to both the chip card manufacturer and consumer. Introduction of a flexible power source, however, can enhance the features provided by the card (e.g., multi-media capabilities). The invention greatly enhances the convenience, efficiency, and practicality of chip cards for their uses.

The invention provides advantages for a wide range of chip card applications. When used with a health care chip card, the invention will allow the cardholder's medical condition and medications to be displayed on the face of the card. If the medication or medical condition changes, the chip card reading/writing device at the pharmacy or doctors office would update the information shown on the display. In an emergency situation, the care giver would have instant knowledge of the patient's medical condition and medications, without having to take the time to locate and use an external card reading device.

In general, in another aspect, the invention features a method of delivering advertisement information from a source of advertisement information to a chip card for display on a display element (e.g., a flexible, color display element) of the chip card. The method includes establishing a communication path between the source and the chip card, transmitting the advertisement information from the source to the chip card via the communication

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path, and displaying the transmitted advertisement information on the chip card display element.

Embodiments may include one or more of the following features. The advertisement information may  
5 include a graphic image or an image sequence. The chip card may store advertisement information for one or more advertisements in chip card memory. The advertisement information displayed on the chip card may be selected from the stored advertisements. The advertisement  
10 information may represent, for example, an image of a coupon or an image of a store map. The chip card may also receive audio information or internet addresses.

The chip card may receive selected advertisement information. Such information may be selected based on  
15 information retrieved from the chip card, such as a chip card identification code, chip card usage data, demographic data, or sound data.

The communication path may include networked computers. Any point in the communication path may block  
20 transmission of the advertisement information.

In general, in another embodiment, the invention features a method of electronic ticketing using a chip card having memory and a display element. The method includes  
25 transmitting ticketing information to chip card memory, and displaying the ticketing information on the chip card display element. The method may further include retrieving data from the chip card to authorize admission.

The invention has numerous advantages. It offers  
30 consumers the ability to receive advertisements, coupons, and other information likely to prove of interest to the consumer. Additionally, paperless transmission of information can speed different transactions and reduce paperwork.

35 The invention also enables businesses to target advertising and other information for transmission to

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customers by analyzing detailed consumer profiles built from demographic and transaction information. The information sent to the chip card is presented to the consumer whenever the consumer uses the chip card.

5 Further, businesses can both send information and collect consumer profile data from the multitude of environments that process chip cards (e.g., telephones, screen phones, computers, ATM machines, parking meters, vending machines, stadium ticket facilities, GSM devices, gas pumps, copy  
10 machines, laundromats, theaters, casino gaming machines, etc.). Additionally, businesses can track the success of their consumer targeting efforts. For example, a business may record when an electronic coupon was sent to a consumer and if and when the consumer redeemed the coupon.

15 The invention also enables consumers to receive ticketing information that can admit them to a venue, guide them to their seats, and even provide coupons for venue concessions.

Other features and advantages of the invention will  
20 be apparent from the following description of preferred embodiments and from the claims.

#### Brief Description of the Drawing

FIGS. 1A-1C show a contact-type chip card with a flexible display element, with the optional magnetic  
25 stripe and bar code on the reverse side of the card.

FIGS. 2A and 2B show a contact-type chip card with a flexible card body and a display element that is located anywhere outside of the cross-hatched area on the card.

FIG. 3 shows a credit card with a contact-type chip  
30 and a flexible display element.

FIGS. 4A and 4B show a contactless chip card with a flexible display element that covers the entire surface of the card on one of the layers of the card.

FIGS. 5A-5C show a chip card with a power source.

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FIG. 6 shows the circuit block diagram for a chip card with a display element.

FIG. 7 shows a kickstart circuit that can control chip card power.

5 FIG. 8 shows a regulator and charge controller that can recharge a power source.

FIG. 9 shows a barrier strip layered over a display element layer to provide stereoscopic effects.

FIG. 10 shows a multi-color display.

10 FIG. 11A-11B are diagrams illustrating chip card features.

FIG. 12 is a diagram of information stored in chip card memory.

15 FIG. 13 is a diagram of a chip card, a chip card reader, and connected equipment.

FIG. 14A-14D are flowcharts of information delivery.

FIG. 15A and 15B are diagrams of embodiments of an information delivery system.

20 FIG. 16A and 16B are flowcharts of information blocking.

FIG. 17 is a diagram of an apparatus for blocking information.

#### Description of the Preferred Embodiments

25 Turning to FIGS. 1A-1C, there is shown a chip card 10 having a transparent protective top layer 12 (PVC or other clear plastic) and transparent (or opaque or translucent) substrate 14 (PVC or other plastic). The top layer and substrate (body) may be molded or machined into 30 the necessary shape to accommodate the internal components of the card. Indicia are printed on the top layer (e.g., on the interior surface), and a hologram (not shown in FIGS. 1A-1C; see 32 in FIG. 3) may be installed beneath the top layer (e.g., a rainbow hologram element as 35 commonly used on credit cards). A conventional magnetic

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stripe 34 and signature panel can be provided on the bottom of the card (FIG. 1B).

An integrated circuit 16 is mounted beneath a printed circuit board 18, which fits within a cutout in the card body. Contacts 20 cover one entire surface of the printed circuit board and the contacts are exposed to the outside of the card through the cutout, to provide electrical connection to the card. The size of the printed circuit board is exaggerated in the cross sectional views, e.g., FIG. 1C; it has the same lateral extent as the connector contacts 20, which cover one surface of the board.

A display element 22 is provided on the top surface of the card. In one implementation, transparent electrodes 24 (indium tin oxide or other substantially clear conductive material) are deposited on the interior surfaces of the top layer (best seen in FIG. 1C) and bottom layer. The electrodes may be configured to provide either a dot matrix pattern or a segmented display pattern. Z-axis conductor 28 (known polymeric material with conductivity only in the Z axis) provides conductive paths from the printed circuit board to the electrodes on the bottom layer. Contact with the electrodes on the top layer is via connections through the Z-axis conductor between the top and bottom layers (i.e., the bottom layer acts as a pass through for connections to the top layer, rather than having the printed circuit board be connected to both layers, thereby simplifying construction).

The electrodes work in conjunction with liquid crystal display (LCD) film 26, which is a bi-stable or multi-stable display material that will maintain an image when power has been removed. In this way, it is unnecessary for the chip card to have its own power source, or be connected to a power source, for the display to function. The preferred LCD material is a ferroelectric LCD. These LCDs are based on smectic liquid

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crystals typically of the smectic C phase with chiral behavior. When formed in a thin layer the ferroelectric material has a net polarization that is perpendicular to the viewing surface. The electrodes apply a field that  
5 rotates polarization between an "on" and an "off" state. Ferroelectric LCDs are typically sensitive to shock or bending, making them unsuitable for use in a chip card that can be bent (e.g., when stored in a wallet). To make the ferroelectric LCD less sensitive to bending, the  
10 ferroelectric liquid crystal (FLC) is fixed to a side-chain of the polymer used to create the LCD film (e.g., as taught in Japanese Patent Document No. 63-318526) or where the FLC is dispersed in the polymer film (e.g., as taught in U.S. Patent No. 5,638,194).

15 Other implementations can include different display elements such as suspended particle displays or field emission displays. These display elements, however, require a power source to display images.

Referring to FIG. 10, a filter layer 88 can add  
20 color to an otherwise monochromatic LCD display. The filter layer 88 may include color filters for red, green, and blue. A pixel 86 either blocks color filtered light or permits the color to illuminate a pixel 86. Though each pixel 86 only shows red, green, or blue, the viewer  
25 spatially integrates the colors to perceive combinations of the above colors (e.g., purple).

Referring to FIG. 11, the display can offer stereoscopic effects such as images that appear three-dimensional and images that alter their appearance based  
30 on viewing angle (e.g., a face that winks as a viewer moves the card). For example, an LCD barrier strip 80 (described in U.S. Pat. No. 5,315,377 to Isono, incorporated by reference) intersperses vision blocking barrier regions with viewing regions to control the image  
35 perceived by a viewer. By choosing appropriate underlying LCD image, the barrier strip 80 alters image appearance.

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As shown in FIG. 11, left eye 76 sees point A, but not point B, while right eye 80 sees point B, but not point A.

Referring again to FIG. 1C, the integrated circuit 16 includes a microprocessor for storing and processing information, and circuitry for powering and controlling the display element. In embodiments that store cash, the display can be configured as a dot matrix display. The display driving circuitry can use a multiplexed technique used in commercial passive displays to quickly refresh the display.

As shown in FIG. 6, the microprocessor 40 controls a driver circuit 42, which develops the voltages appropriate to activate and deactivate the display element pixels. A power source on the card or an external power source (e.g., a card reader) can provide the power needed by the microprocessor 40 and other stages. Polarity switch 44 at the output of the driver circuit selects whether the row or column electrode is to receive the positive polarity. Row/column selector switch determines which specific row/column pair receives the voltages produced by the polarity switch and driver circuit. Microprocessor 40 controls the driver circuit 42, polarity switch 44, and row/column selector switch 46.

The microprocessor 40 can also support multiple applications. Many smart cards support the Java programming language. Such applications may include compression/ decompression applications that reduce the amount of information exchanged between the card and a card reader.

The assembled chip card may safely undergo flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse)" by which is meant flexing the card through the following five tests with the card still functioning and with it not showing any cracked part (see ISO 7816-1, hereby incorporated by reference):

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1. With the contacts facing up, bend the long side -  
of the card through a deflection of 2 cm at a rate of 30  
bendings per minute, for a total of 250 bendings.

2. With the contacts facing down, bend the long  
5 side of the card through a deflection of 2 cm at a rate of  
~~30 bendings per minute, for a total of 250 bendings.~~

3. With the contacts facing up, bend the short  
side of the card through a deflection of 1 cm at a rate of  
30 bendings per minute, for a total of 250 bendings.

10 4. With the contacts facing down, bend the short  
side of the card through a deflection of 1 cm at a rate of  
30 bendings per minute, for a total of 250 bendings.

5. Place the card in a machine that applies  
torsion to its short sides, the maximum displacement being  
15 15 degrees (plus or minus 1 degree) in alternative  
directions at a rate of 30 torsions per minute for a total  
of 1,000 torsions.

Alternatively, the assembled chip card may safely  
undergo "approximately 50% of the flexing of the type and  
20 magnitude experienced by a card during normal use,  
handling, and storage (e.g., storage in a pocket, wallet,  
or purse)" by which is meant bending and torsioning the  
card through the same five bending and torsion tests  
described above, but with 50% of the given amounts of  
25 deflection (1 and 0.5 cm instead of 2 and 1 cm) for the  
bending tests (1-4) and 33.3% of the given amount of  
angular displacement (5 degrees instead of 15 degrees) for  
the torsion tests (5), with the card still functioning and  
with it not showing any cracked part.

30 In performing the above tests, correct functioning  
of the card should be ascertained every 125 bends or  
torsions.

The display may not function perfectly, or at all,  
while the card is flexed into a curved shape, but once the  
35 card is allowed to assume its original shape the display  
will again function correctly. Contributing to this

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flexibility are the polymer substrates (top and bottom layers) and the z-axis conductor for making connections between the printed circuit board and the display. The z-axis conductor can withstand the variable compression that flexing produces.

FIGS. 2A and 2B show a chip card in which the display element is made tolerant of flexing by being located in an area of the card that does not undergo substantial flexing. The display element is located at the corners of the card, outside of the cross-hatched areas in the figures. The cross-hatched area consists of a horizontal band and a vertical band. Preferably, as shown in FIG. 2A, the horizontal band is 6 millimeters wide, and the vertical band 15 millimeters wide. More preferably, as shown in FIG. 2B, the horizontal band is 11 millimeters wide, and the vertical band 30 millimeters wide. FIGS. 5B and 5C show a card featuring multiple display elements.

FIG. 3 shows a credit card 10 comprising a contact-type chip card with contacts 18 and flexible display element 22. Printed lettering 52 and embossed card numbers (and expiration date) 50 are included, as is a hologram 32.

FIGS. 4A and 4B show a contactless chip card with a flexible display element covering substantially the entire surface of the card. A wireless communication element (not shown) is connected to printed circuit board 18. Z-axis conductor 28 connects the printed circuit board to the upper transparent electrodes of the display element. Lower transparent electrodes are connected directly to the printed circuit board. Some printed lettering 52 is used, but all of the lettering could be provided by the display.

FIGS. 5A-5C show a chip card incorporating a power source (e.g., a battery or solar cell element) 38. The card may feature a small inflexible battery (e.g., a

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supercap) positioned in an area of the card that does not undergo substantial flexing, or, preferably, a flexible thin-film lithium battery, such as Oak Ridge National Laboratories' thin-film battery.

5 Inclusion of a power source 38 can enhance card  
----- functions with a variety of capabilities including multi-----  
media. For example, in FIGS. 5B and 5C, the power source  
38 drives a flexible speaker/microphone 54 that offers  
multiple-octave sound in a slim profile device (e.g., U.S.  
10 Patent No. 5,115,472 to Park describes a flexible  
piezoelectric speaker/microphone made of polymer films,  
and is incorporated herein). Other types of speakers or  
microphones may be used that do not offer similar  
flexibility, but may nevertheless be positioned in an area  
15 of the card that does not undergo substantial flexing.

Addition of a power supply 38 can also produce  
animation sequences on the display element 22. By  
retrieving and displaying different sections of  
information stored in the semiconductor chip at successive  
20 time periods, the card can produce a series of images  
(e.g., a video clip or slide-show) on the display 22.

A card can provide several methods of controlling  
output from a power source 38 to conserve card energy.  
Referring to FIG. 7, the card can incorporate a kickstart  
25 circuit 70 (e.g., a flip-flop 70 that controls power  
source 38) connected to a user controlled contact area 58.  
Pressing the contact area 58 causes the kickstart circuit  
70 to initiate power output from the power source 38. The  
kickstart circuit can provide power for a pre-determined  
30 time period or until a subsequent pressing of the contact  
area 58 as shown. In another implementation, the contact  
area 58 could instead merely connect otherwise  
disconnected wires to draw power from the power source 38.  
As mentioned, however, in the preferred embodiment, the  
35 display element does not need power to display a static  
image when the power source does not deliver power. The

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contact area 58 can control other card functions, for example, clearing the display element.

Both contact and contactless cards can use a power source 38. While both card types could use a card design that offers access to a power source 38 for simple replacement, each type of card may offer various recharge capabilities. For example, as shown in FIG. 8, a card could include a regulator charge control circuit 74 that accepts current and voltage from an external power source (e.g., a card reader) via contacts 20 for storage in a battery 38. A contactless card can recharge a power supply 38 from communication signals boosted to both transmit information and power.

Referring to FIG. 11A, the flexible chip card and other chip cards can be used in a system for transmitting information to a chip card. The chip card 100 shown includes two display elements 114a-114b. Such a configuration permits an orchestrated chip card 100 display where one display element 114a displays a stored value (e.g., a seat number), while the other 114b displays other graphic information (e.g., a theater seat map or directions to the theater). A chip card 100 may instead offer a single display element that nearly covers an entire side of the chip card 100. As shown, display element 114b features graphics of an electronic coupon for a product and a map indicating the location of the product within a store. A store chip card reader at a checkout line can redeem the electronic coupon after verifying purchase of the product (e.g., by comparing a Universal Product Code (UPC) stored in the card with a UPC code identified by a bar code scanner).

Referring to FIG. 11B, instead of providing its own display element, speaker, etc., a card 100 may fit within a portable chip card reader 115 that offers a display element 114c and/or speaker 117. The chip card 100 may

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send graphic image and sound information to the portable chip card reader 115 for presentation.

Referring to FIG. 12, information stored in an integrated circuit 16 can include card identification 128, 5 usage history information 130, audiovisual information

~~-----132, and applications 133. Card identification 128-----~~  
information may include a card serial number and potentially demographic or biographic data describing the card owner (e.g., age, gender, etc.). Usage history 130 10 may include data describing prior uses of the card such as the location, time, and nature of such uses (e.g., March 17 12:00 \$1.00/vending machine/Main Street).

Audiovisual information 132 may include graphic information, sound information, or both. Graphic 15 information can use a variety of data formats including JPEG and GIF. Audiovisual information 132 may also include text. Further, image information may be a sequence of images that provide image animation. Both a chip card with a display and a portable chip card reader 20 can access and present the audiovisual information 132. The information 132 may form advertisements (e.g., product descriptions, electronic coupons, etc.), maps, or other helpful information. The information 132 may further include network addresses. Storing network addresses 25 enables a chip card owner to insert a chip card 100 into a chip card reader connected to a computer and visit a website for more information related to the information presented on the chip card. Information 132 may also include a time stamp indicating when the card received the 30 information 132.

The card may store information 132a-132n for several different presentations of audiovisual information. The integrated circuit 116 may rotate the information 132a-132n the chip card features (i.e., 35 displays or plays on the speaker) at fixed intervals or based on events (e.g., usage). Alternately, a card owner

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may manipulate card controls to replay stored audiovisual presentations, for example, to retrieve an electronic coupon, reread map directions, or reexamine a company's advertisement. The ability to replay presentations can  
5 foster competition among producers to make presentations  
----- consumers repeatedly view. -----

Referring to FIG. 13, a chip card reader 134 can download audiovisual information to the chip card 100 via a communication path 123 that includes chip card contacts  
10 or wireless communication. Downloading may occur during other chip card reader 134 uses (e.g., during a chip card paid phone call). The chip card reader 134 may be a stand-alone chip card reader, a computer peripheral, or a portable chip card reader. The chip card reader 134 may  
15 include software 138 and a database of audiovisual information 136. The chip card reader 134 not only sends information to the chip card 100, but may also store data describing the chip card transaction including which information the chip card reader 134 downloaded to the  
20 chip card 100. Subsequent analysis of collected information can enable businesses to track the effectiveness of their advertising efforts. The software 138 may select information for one or more presentations from the database 136 for transmission to the chip card.

25 In a batch system, information describing chip card transactions may be periodically transferred to a host computer for analysis and storage. Such transfer may occur over a temporary modem connection or a visit by a service person. At the same time, new presentations or  
30 software 138 may be uploaded to the chip card reader 134.

Preferably, the chip card reader 134 connects to a host computer 142 via a network 140. In a network configuration, the host computer 142 may include software 146 that accesses a database of advertisement information  
35 144. Potentially, the host computer 144 stores a more

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extensive database of advertisement information and offers -  
more sophisticated analysis software 146.

Referring to FIGS. 14A-14D, a chip card reader may  
transmit audiovisual information to a chip card with  
5 varying degrees of sophistication. As shown in FIG. 14A,  
~~a chip card reader may simply send (148) the same~~  
audiovisual information to each chip card the reader  
encounters. For example, a store may transmit the same  
graphic image of an electronic coupon to each wireless  
10 chip card that passes through a store entrance. The image  
may include a map indicating the location of the product.  
The audiovisual information may further include signals  
that cause the chip card to generate a sound alerting an  
owner entering a store of a new chip card presentation.

15 FIG. 14B shows a slightly more sophisticated method  
of transmitting audiovisual information. In FIG. 14B, the  
chip card reader selects audiovisual information for  
transmission based on factors (150) such as the time,  
amount, or type of transaction. For example, someone  
20 purchasing cereal in the morning may find a chip card  
coupon for milk very useful.

FIG. 14C shows a method of transmitting  
audiovisual information with even greater sensitivity to  
a particular customer. In FIG. 14C, the chip card reader  
25 retrieves information (152) from the chip card. The chip  
card reader can use this retrieved information (e.g.,  
demographic data, usage history, or card serial number)  
to select appropriate audiovisual information for delivery  
. For example, if the card chip reader determines, either  
30 by retrieving usage history information from the card or  
using a retrieved card serial number to find such  
information in its own database, that a customer buys ice  
cream weekly, the chip card reader 134 may send an ice  
cream coupon to the chip card 100.

35 FIG. 14D shows a delivery method similar to that of  
FIG. 14C with the addition of a networked computer that

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may store audiovisual information and selection software in addition to or in lieu of storing these elements in the chip card reader. A networked computer can both control the audiovisual information dispensed by different card  
5 readers and efficiently collect chip card usage data.

~~The chip card reader may send retrieved chip card~~  
information over the network (156) for processing and receive audiovisual information from the networked computer (158). Many permutations of this configuration  
10 are possible, both in the arrangement of the elements and in the information exchanged. For example, rather than sending audiovisual information for each transaction, a computer may periodically download audiovisual information to chip card readers en masse, then merely transmit  
15 audiovisual information indices to the chip card reader, reducing the amount of information transmitted over the network.

FIGS. 15A and 15B illustrate different embodiments that deliver audiovisual information to chip card readers.  
20 In FIG. 15A, a chip card reader 134 connects to a host computer 142 via a communication path 123 that includes a communication link 140. In FIG. 15B, a chip card reader 134 attached to a computer connects to a host computer 142 via a communication path 123 that includes the internet  
25 140.

Referring now to FIG. 16A, software 164 (or firmware or hardware) within the chip card may block unwanted information transmission by putting the chip card in protect mode. In protect mode, the card does not store  
30 audiovisual information transmitted (174). This prevents a chip card from storing unwanted information that may potentially overwrite information of interest. The protect mode may apply to chip card memory as a whole or to individual presentations.

35 Referring now to FIG. 16B, other points in the transmission path may block information transmission

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(176). For example, the host computer may recognize the card serial number as belonging to a card owner uninterested in receiving advertisements. Referring now to FIG. 17, the card owner may interact with a chip card reader that features a "do not download information" button 176 that prevents transmission of information from the chip card reader to the chip card. Again, many permutations of the above are possible.

A variety of applications can make effective use of the above described techniques. For example, a stadium chip card system can quickly download electronic tickets for single or multiple events to a chip card along with seat and stadium location information. The ticket information can appear on the chip card display. This can occur at purchase time over a network, reducing box-office lines. Admission into the stadium by chip card would present an opportunity to download stadium specific information to each chip card such as the location of facilities or coupons for concession refreshments (e.g., cotton candy for a circus or hot-dogs for a ball game). Of course, the stadium could generate revenue by downloading an outside business' information for a fee.

Other embodiments of the invention are within the following claims. E.g., other materials could be used for the flexible top layer and substrate, and a co-processor could be included in the card.

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What is claimed is:

1. A chip card for providing portable storage of information, the chip card comprising:

a flexible body;

5 ~~at least one semiconductor chip supported within~~  
the flexible body and comprising a memory for storing the information;

a display element capable of displaying at least a portion of the information stored in the semiconductor  
10 chip, the display element being supported within the flexible body and comprising display areas viewable from at least one side of the chip card;

circuitry for controlling the display element;  
the chip card being capable of undergoing flexing of the  
15 type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse) without permanent damage to the display element and without permanent loss of the displayed information.

20 2. The chip card of claim 1, wherein the display element is capable of undergoing flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse) without permanent damage to the display element  
25 and without permanent loss of the displayed information.

3. The chip card of claim 1, wherein the display element is capable of undergoing approximately 50% of the flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in  
30 a pocket, wallet, or purse) without permanent damage to the display element and without permanent loss of the displayed information.

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4. The chip card of claim 1, wherein the display element is located in an area of the chip card that does not undergo substantial flexing.

5. The chip card of claim 4, wherein the display  
-----5- element is located in the corners of the chip card outside  
of central horizontal and vertical bands at least 6 mm and  
15 mm wide, respectively.

6. The chip card of claim 5, wherein the  
horizontal and vertical bands are at least 11 mm and 30  
10 mm, respectively.

7. The chip card of claim 1, wherein the display element is capable of continuing to display information after electrical power is removed from the display element.

15 8. The chip card of claim 1, further comprising contacts exposed on a surface of the card for communication with the semiconductor chip.

9. The chip card of claim 1, further comprising a  
wireless communication element within the card for  
20 communication with the semiconductor chip.

10. The chip card of claim 1, further comprising internal connection elements connecting the semiconductor chip to the display element, the internal connection elements being configured so as to be capable of  
25 undergoing flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse) without permanent loss of the connection provided by the connection elements.

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11. The chip card of claim 1, further comprising internal connection elements connecting the semiconductor chip to the display element, the internal connection elements being configured so as to be capable of

5 undergoing approximately 50% of the flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse) without permanent loss of the connection provided by the connection elements.

10 12. The chip card of claim 1, wherein the flexible body comprises at least one of the following flexible materials: plastic, paper, reinforced paper, and cardboard.

13. The chip card of claim 12, wherein the flexible body comprises at least one of the following flexible materials: polyvinyl chloride, polyester, ABS, and polycarbonate.

14. The chip card of claim 1, further comprising at least one substantially transparent layer of protective plastic covering the display element.

15. The chip card of claim 1, wherein the display element is capable of undergoing flexing of the type and magnitude experienced by a card during normal use, handling, and storage (e.g., storage in a pocket, wallet, or purse) without permanent damage to the display element and without permanent loss of the displayed information;

the display element is capable of continuing to display information after electrical power is removed from the display element;

the flexible body comprises at least one of the following flexible materials: polyvinyl chloride,

- 25 -

polyester, ABS, polycarbonate, paper, and reinforced paper.

16. The chip card of claim 1, further comprising at least one additional information storage medium in

-----5----- addition to the semiconductor chip.

17. The chip card of claim 16, wherein the additional storage medium comprises at least one of a bar code symbol and a magnetic strip element.

18. The chip card of claim 1, further comprising a  
10 co-processor device within the card.

19. The chip card of claim 1, further comprising a power source.

20. The chip card of claim 19, wherein the body facilitates power source replacement.

15 21. The chip card of claim 19, wherein the power source comprises a rechargeable power source.

22. The chip card of claim 21, further comprising a regulator and charge controller that recharges the power source.

20 23. The chip card of claim 19, further comprising a kickstart circuit that controls power output.

24. The chip card of claim 19, further comprising a speaker powered by the power source.

25 25. The chip card of claim 24, wherein the speaker comprises a piezoelectric speaker.

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26. The chip card of claim 19, further comprising a microphone powered by the power source.

27. The chip card of claim 26, wherein the microphone comprises a piezoelectric microphone.

5 28. The chip card of claim 19, wherein the power supply causes the semiconductor chip to retrieve different portions of the information stored in the semiconductor chip and successively display these different portions on the display element.

10 29. The chip card of claim 1, further comprising at least one additional display element.

30. The chip card of claim 1, wherein the display element comprises a multi-color display.

15 31. The chip card of claim 1, wherein the display comprises a display that offers stereoscopic effects.

32. The chip card of claim 31, wherein the display incorporates a barrier strip to provide the stereoscopic effects.

20 33. A chip card for providing portable storage of information, the chip card comprising:

a body;

at least one semiconductor chip supported within the body and comprising a memory for storing information; and

25 at least one multi-media element coupled to the semiconductor chip.

34. The chip card of claim 33, wherein the multi-media element comprises a speaker.

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35. The chip card of claim 34, wherein the speaker - comprises a piezoelectric speaker.

36. The chip card of claim 33, wherein the multi-media element comprises a microphone.

---

5 37. The chip card of claim 36, wherein the microphone comprises a piezoelectric microphone.

38. The chip card of claim 33, wherein the multi-media elements comprise  
a display coupled to the semiconductor chip, and  
10 semiconductor chip instructions that cause the semiconductor chip to alter the display at intervals.

39. A method of delivering advertisement information from a source of advertisement information to a chip card for display on a display element of the chip  
15 card, comprising:  
establishing a communication path between the source and the chip card;  
transmitting the advertisement information from the source to the chip card via the communication path; and  
20 displaying the transmitted advertisement information on the chip card display element.

40. The method of claim 39, wherein the advertisement information comprises at least one of the following: an image and an image sequence.

25 41. The method of claim 39, further comprising storing the advertisement information in chip card memory.

42. The method of claim 39, wherein chip card memory stores advertisement information representing a plurality of advertisements.

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43. The method of claim 42, further comprising selecting at least one advertisement for display from the plurality of advertisements stored in chip card memory.

44. The method of claim 39, wherein the  
5 advertisement information comprises an image of a coupon.

45. The method of claim 39, wherein the advertisement information comprises an image of a store map.

46. The method of claim 39, wherein the  
10 advertisement information describes a product.

47. The method of claim 39, wherein the display element comprises a flexible, color display element.

48. The method of claim 39, further comprising transmitting audio data to the chip card via the  
15 communication path.

49. The method of claim 39, further comprising transmitting an internet address to the chip card via the communication path.

50. The method of claim 39, further comprising,  
20 prior to transmitting the advertisement information, selecting advertisement information for transmission.

51. The method of claim 39, further comprising retrieving data stored in chip card memory.

52. The method of claim 51, wherein the retrieved  
25 data comprises at least one of the following: a chip card identification code, chip card usage data, demographic data, and sound data.

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53. The method of claim 51, further comprising selecting advertisement information for transmission based on the data retrieved from chip card memory.

54. The method of claim 39, wherein the  
~~5-communication-path-comprises-a-path-via-networked~~  
computers.

55. The method of claim 39, further comprising blocking transmission of the advertisement information to the chip card at a point in the communication path.

10 56. A method of electronic ticketing using a chip card having memory and a display element, comprising:  
transmitting ticketing information to the chip card; and  
displaying the ticketing information on the chip  
15 card display element.

57. The method of claim 56, further comprising retrieving data from the chip card to authorize admission.

58. The method of claim 56, wherein ticketing information comprises at least one of the following: a  
20 seat assignment, a date, and a map.

59. A method of advertising using a chip card, comprising:

selecting an electronic advertisement for transmission to the chip card; and  
25 transmitting the selected electronic advertisement to the chip card.

60. The method of claim 59, wherein an electronic advertisement comprises at least one of the following: graphic image data and audio data.

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61. The method of claim 59, wherein an electronic advertisement comprises at least one of the following: a coupon image, a product description, and a store map.

62. The method of claim 59, further comprising  
5 ~~displaying the electronic advertisement on the chip card~~  
display element.

63. The method of claim 59, further comprising displaying the electronic advertisement on a chip card reader.

10 64. The method of claim 59, further comprising tracking subsequent chip card transactions to analyze the effectiveness of the transmitted advertisement information.

65. A method of transmitting graphic image  
15 information from a source of graphic image information to a chip card for display, comprising:  
establishing a communication path between the source of image information and the chip card;  
transmitting the graphic image information from the  
20 source to the chip card via the communication path; and  
displaying the transmitted graphic image information on a chip card reader.

66. The method of claim 65, further comprising transmitting audio information via the communication path.

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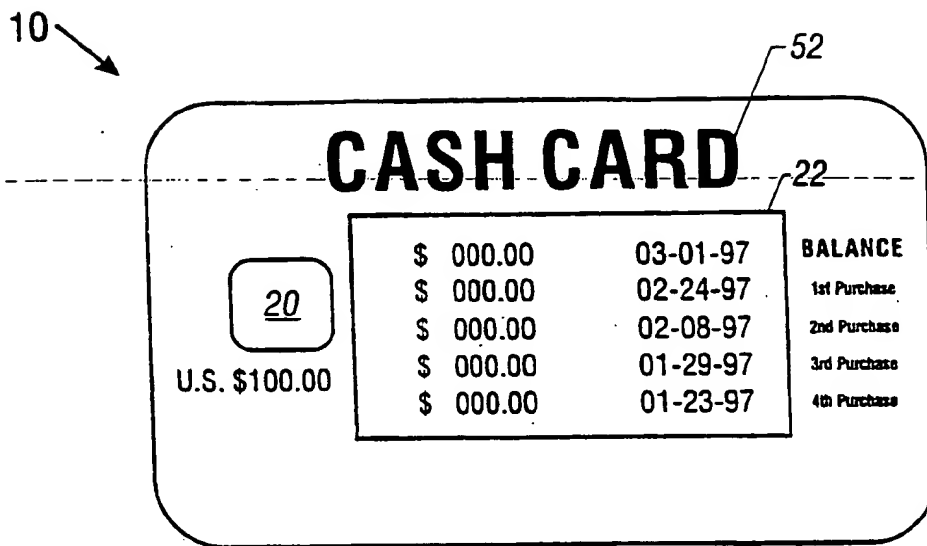


FIG. 1A

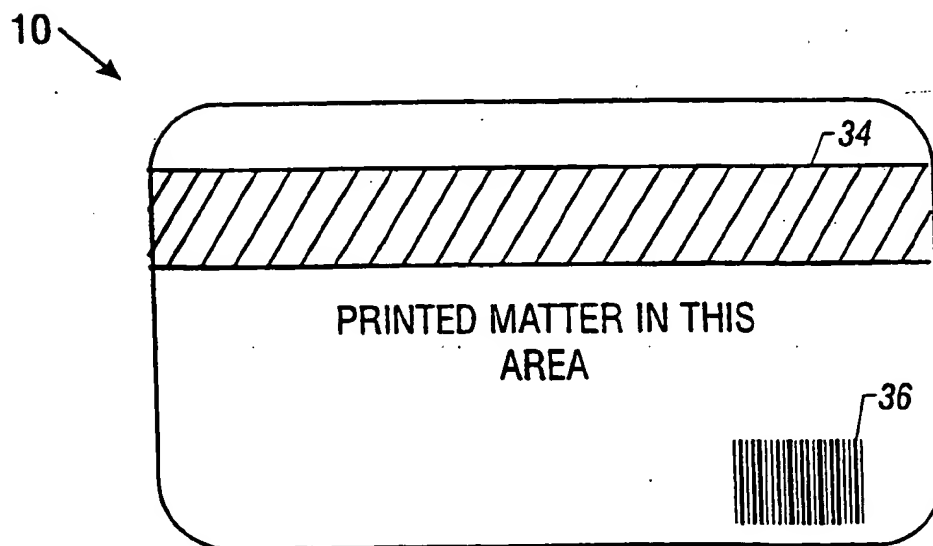


FIG. 1B

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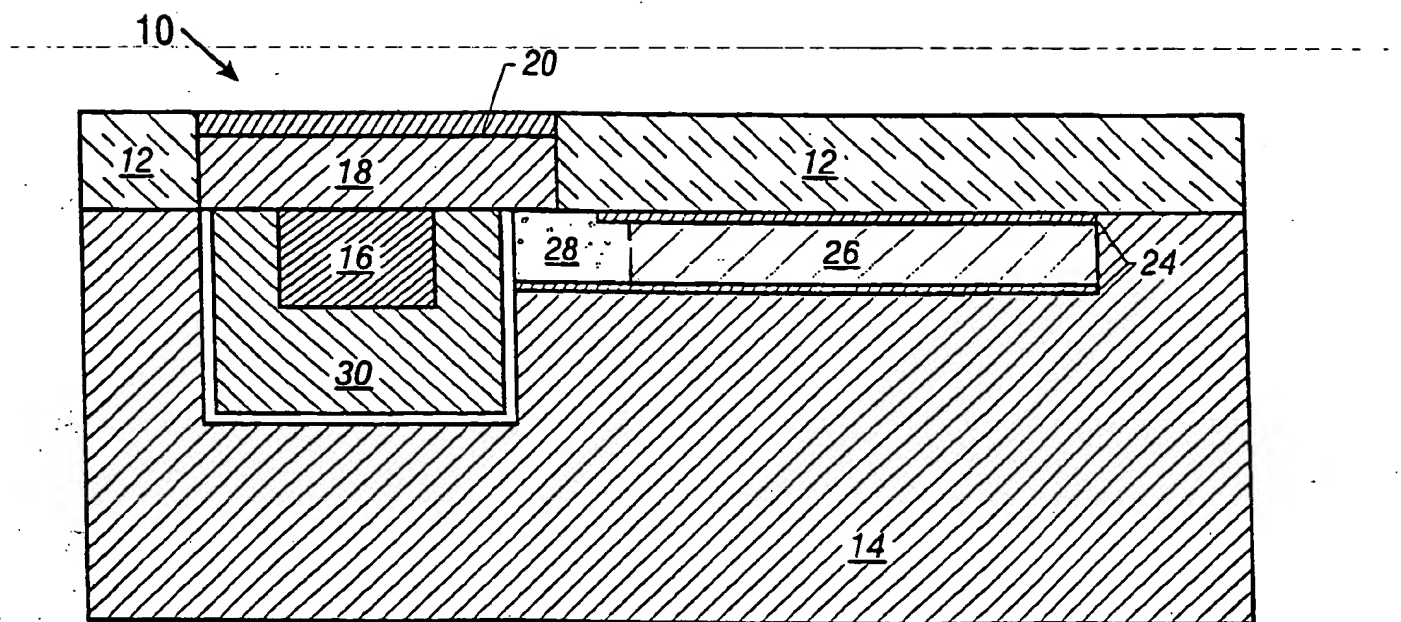


FIG. 1C

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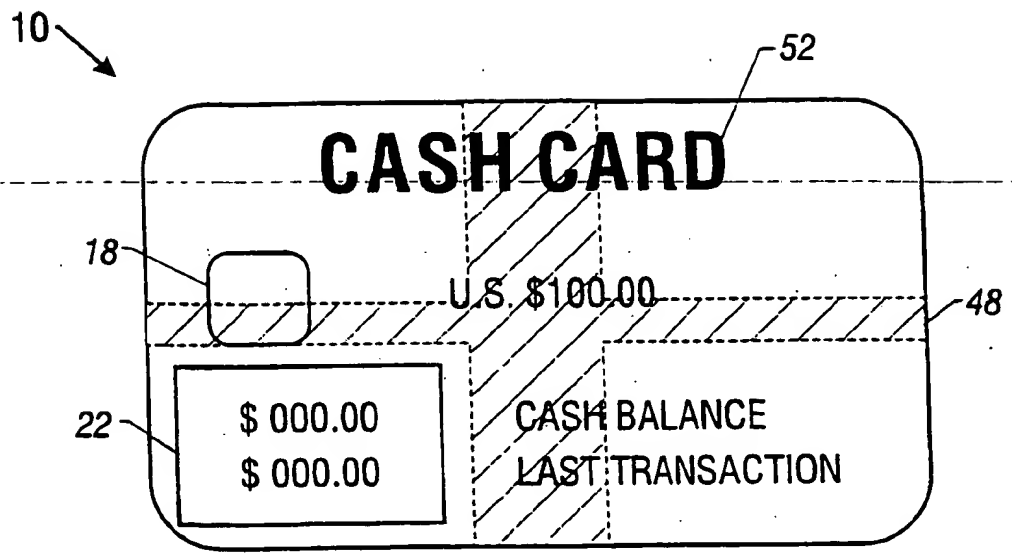


FIG. 2A

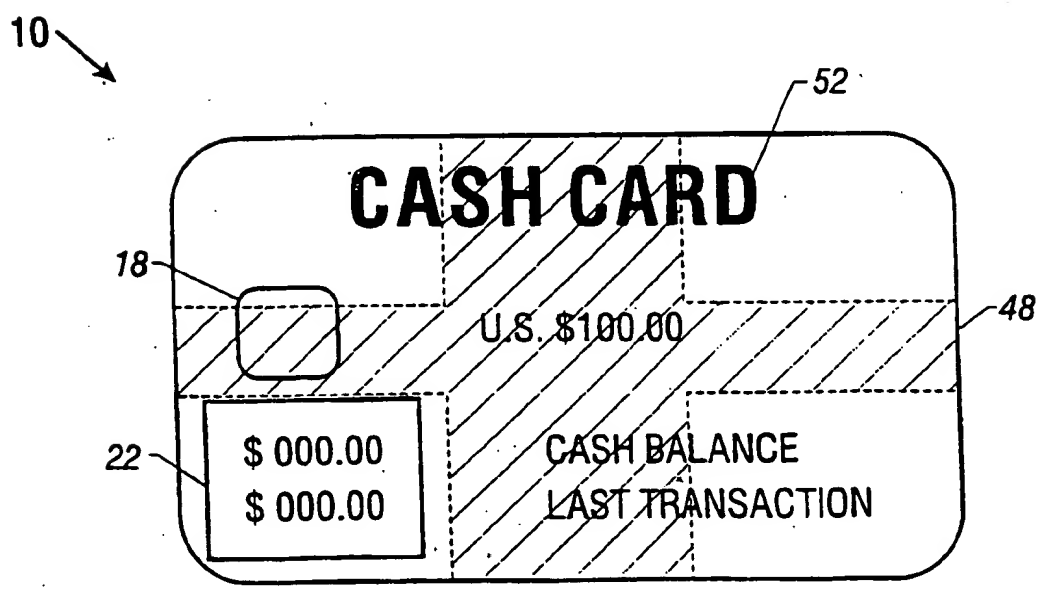


FIG. 2B

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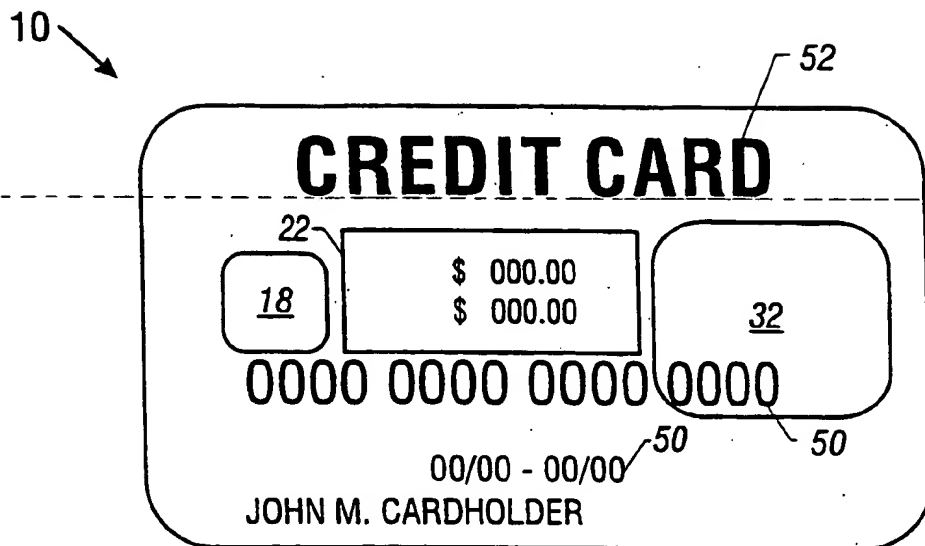


FIG. 3

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10

TRANSIT CARD		
52	BALANCE	\$ 000.00 03-01-97
	1st Purchase	\$ 000.00 02-24-97
	2nd Purchase	\$ 000.00 02-08-97
	3rd Purchase	\$ 000.00 01-29-97
	4th Purchase	\$ 000.00 01-23-97
	5th Purchase	\$ 000.00 01-11-97

26

FIG. 4A

10

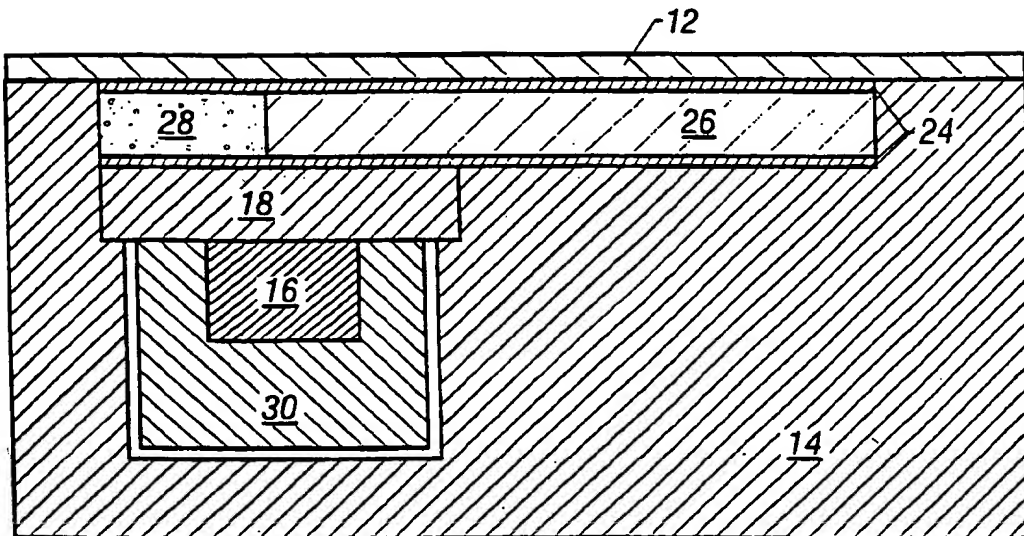


FIG. 4B

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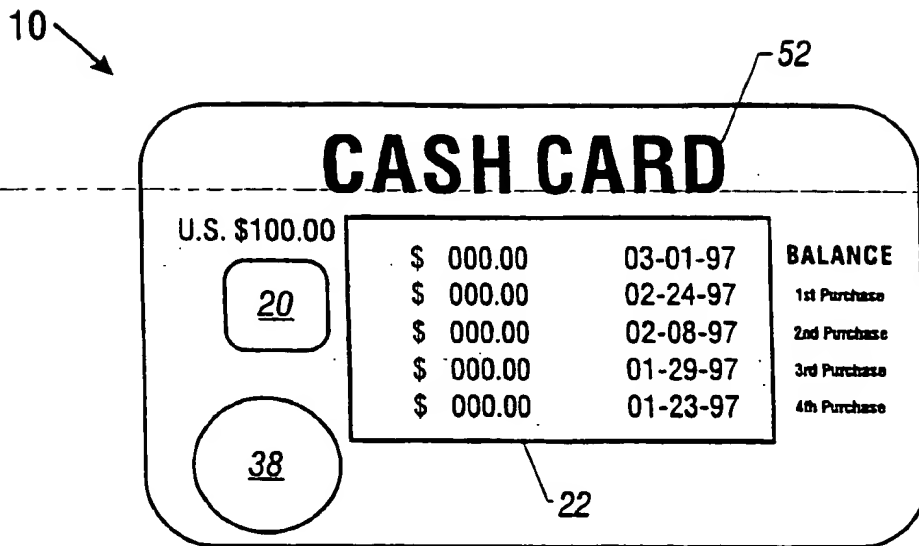


FIG. 5A

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10

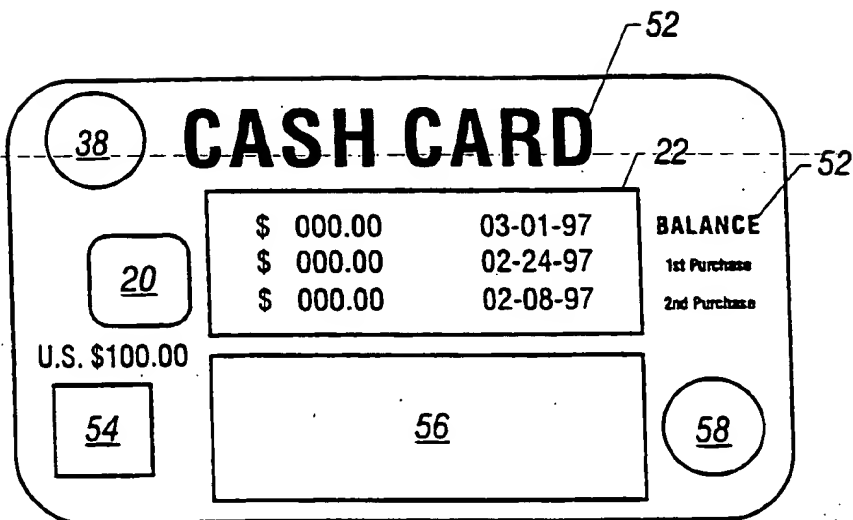


FIG. 5B

10

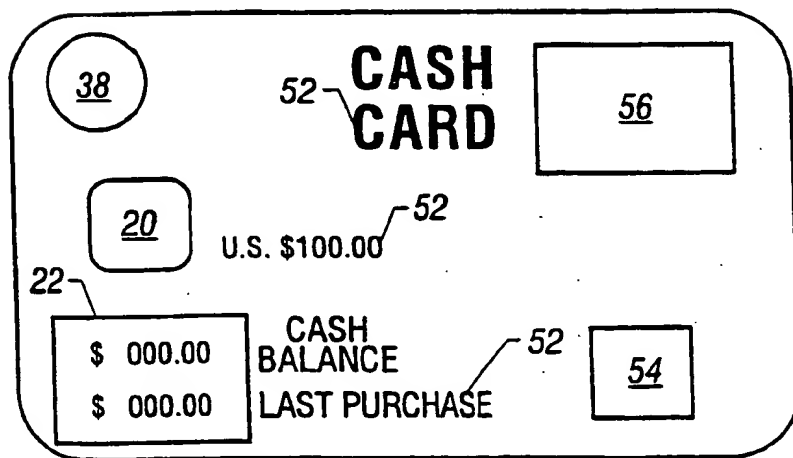


FIG. 5C

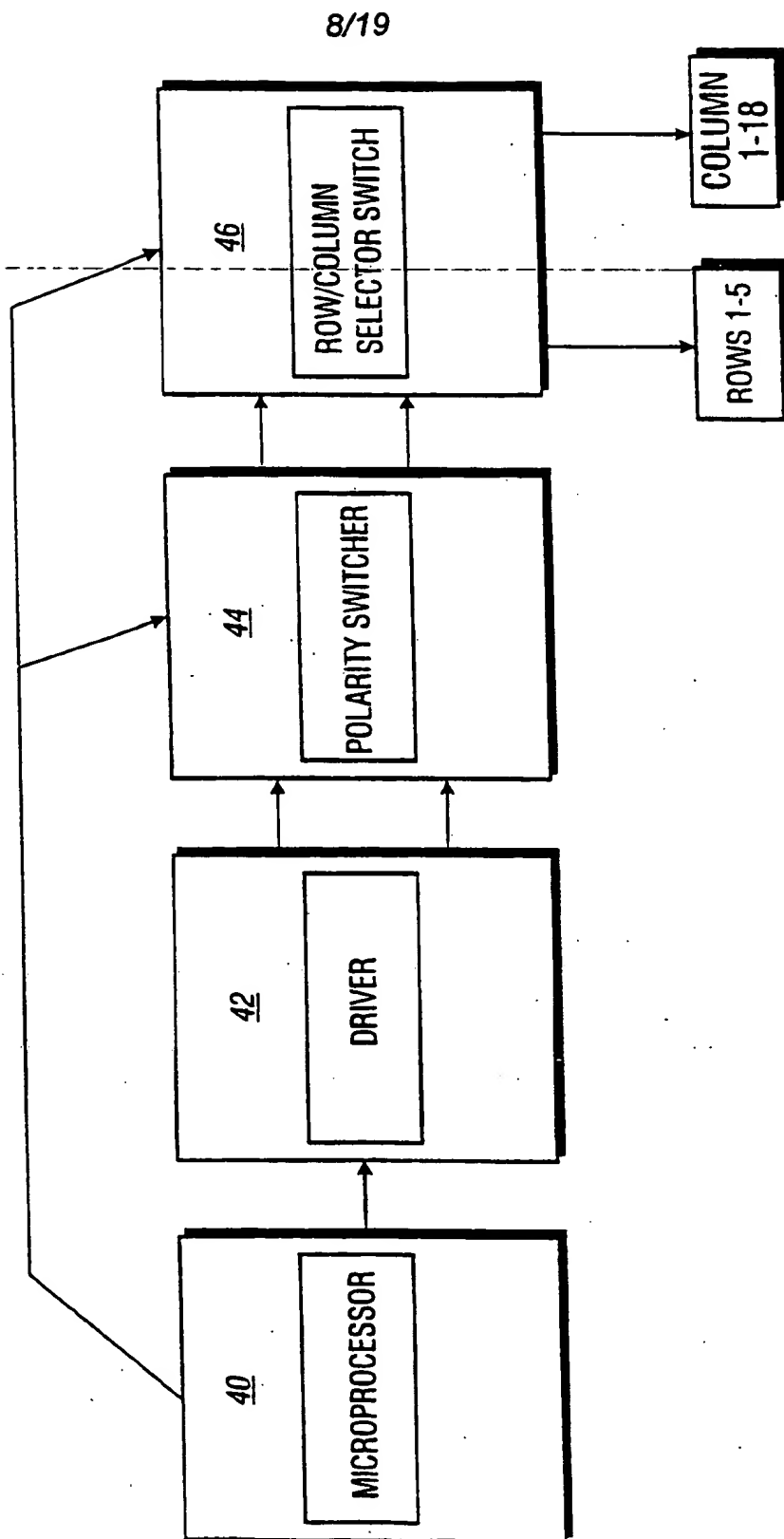


FIG. 6

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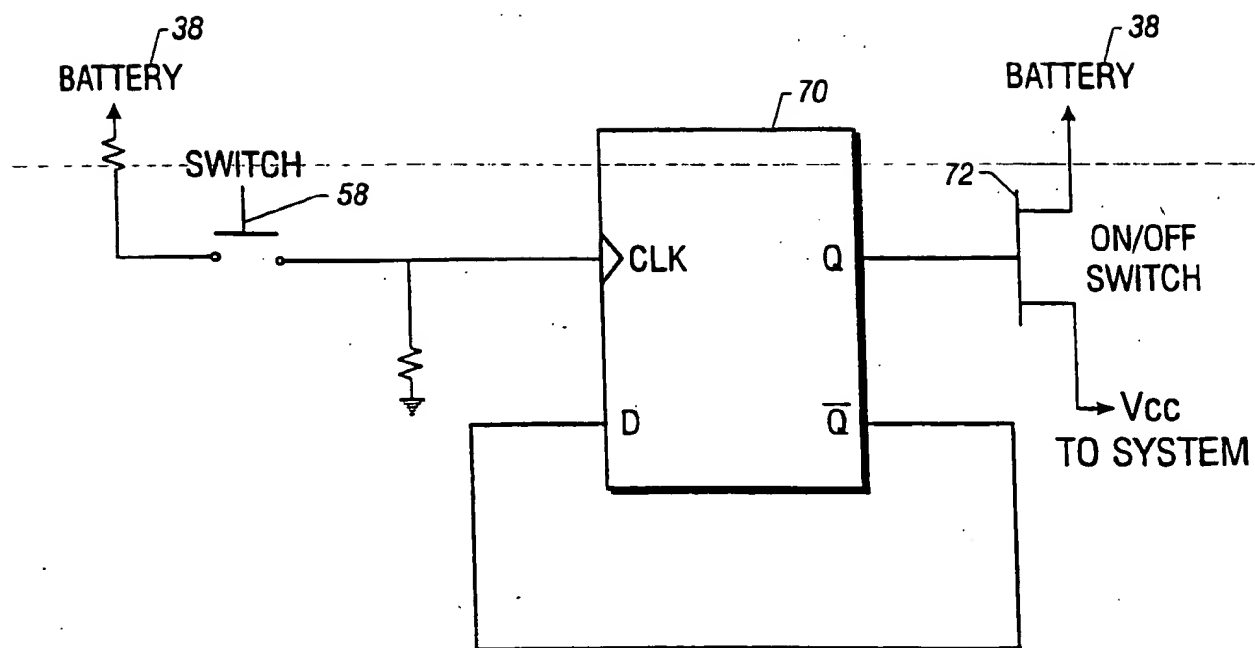


FIG. 7

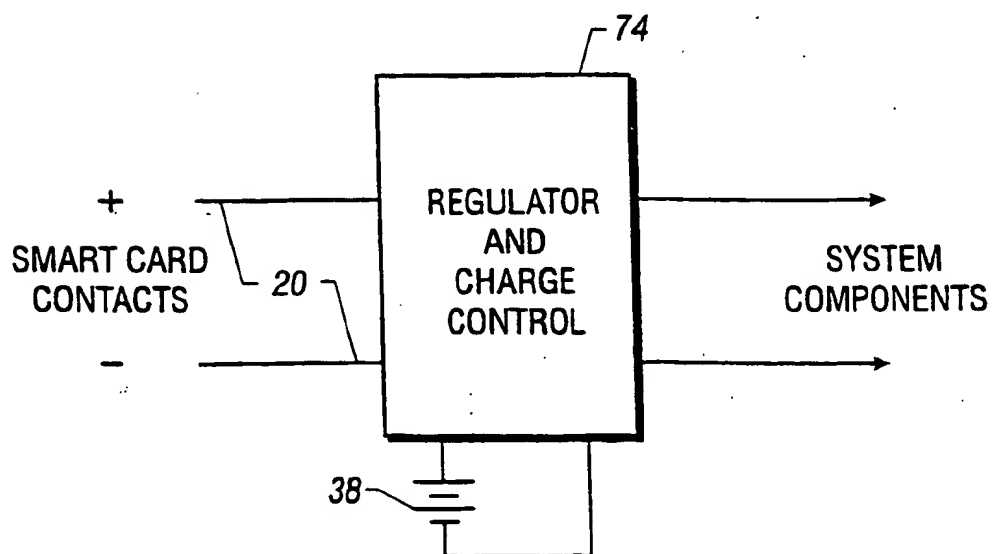


FIG. 8

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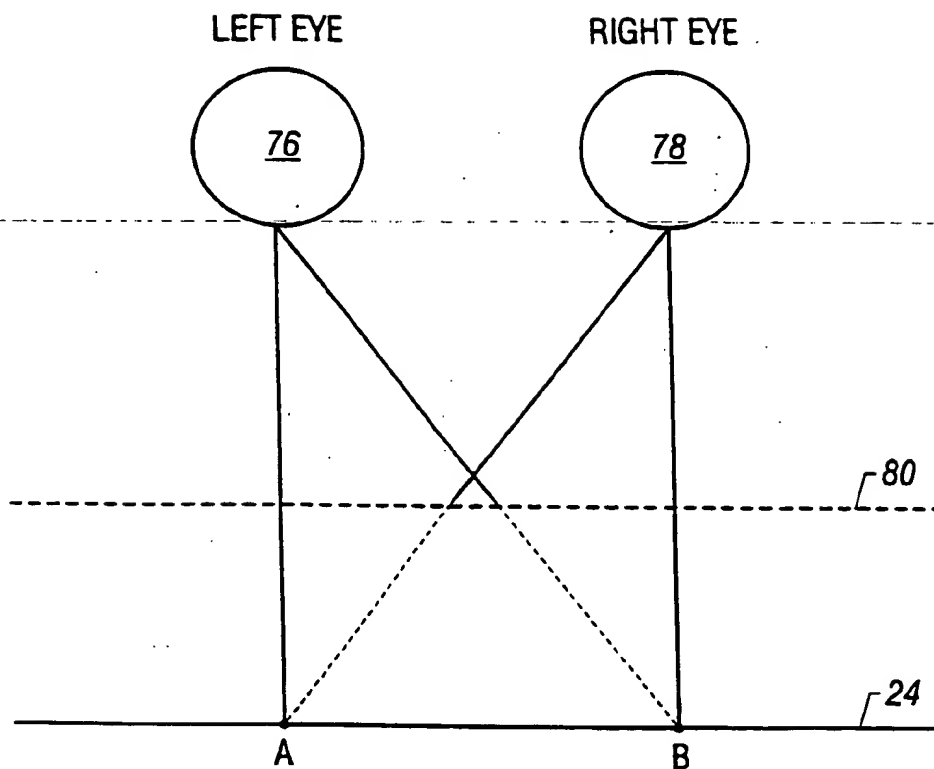


FIG. 9

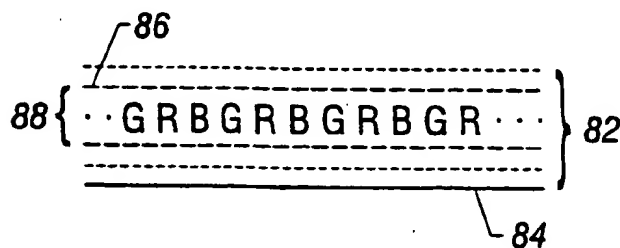


FIG. 10

11/19

100

100

38

# CASH CARD

52

114a

52

\$ 000.00	03-01-97	BALANCE	
\$ 000.00	02-24-97		1st Purchase
\$ 000.00	02-08-97		2nd Purchase

20

U.S. \$100.00

54

114b

58

10¢ off soda <input checked="" type="checkbox"/>	
CHIPS	* SODA *
Aisle 10 →	
HEALTH FOOD	SHAMPOO

FIG. 11A

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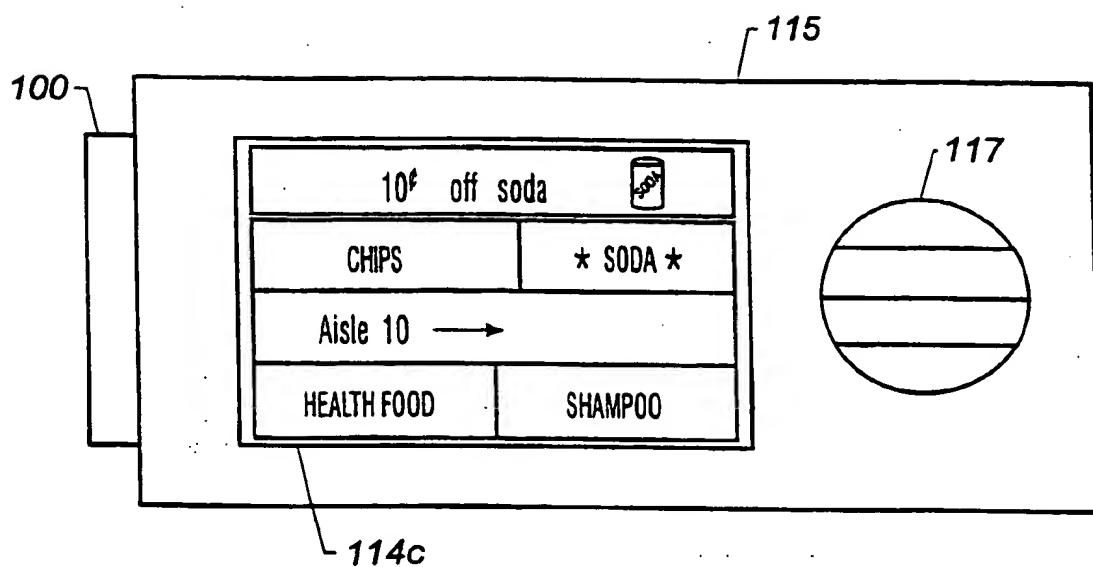


FIG. 11B

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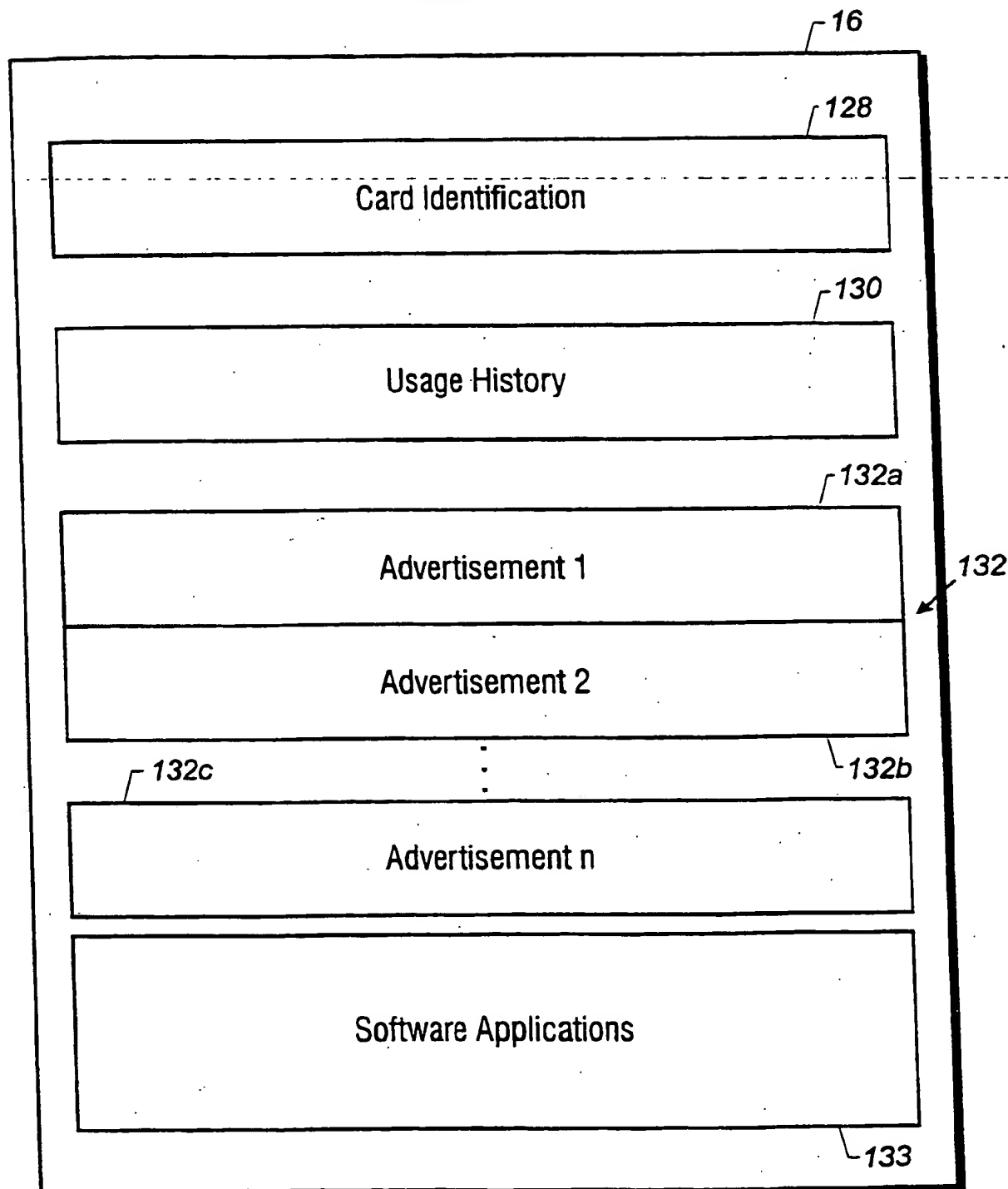
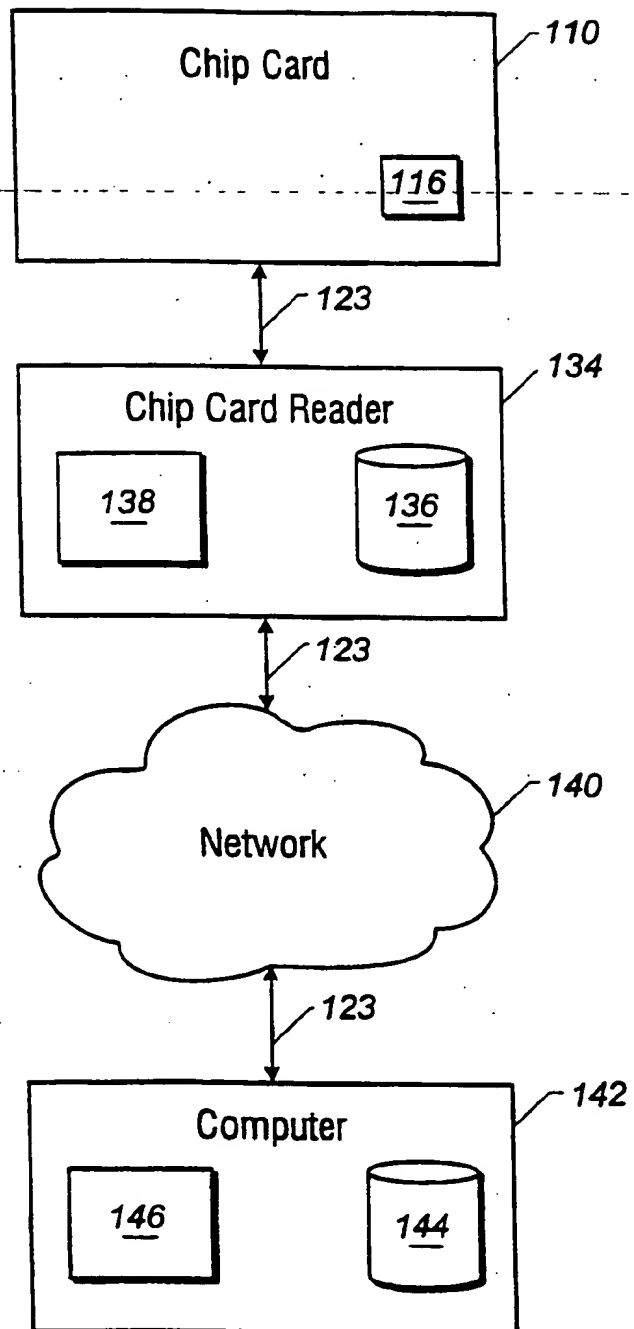


FIG. 12

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**FIG. 13**

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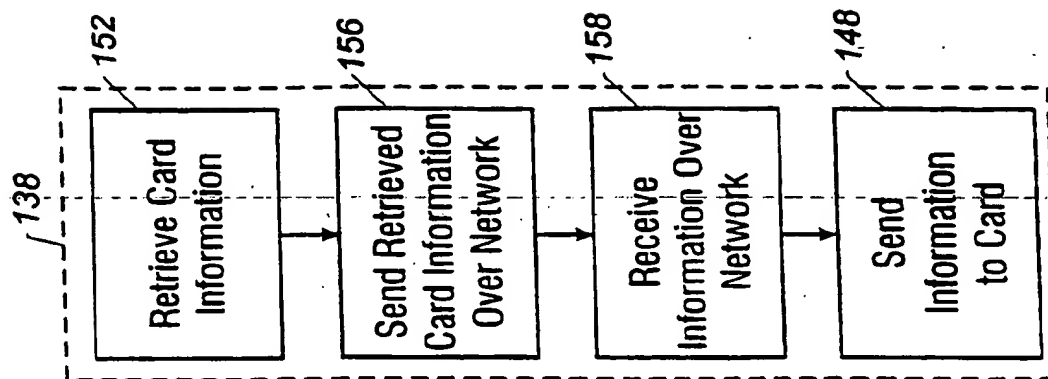


FIG. 14D

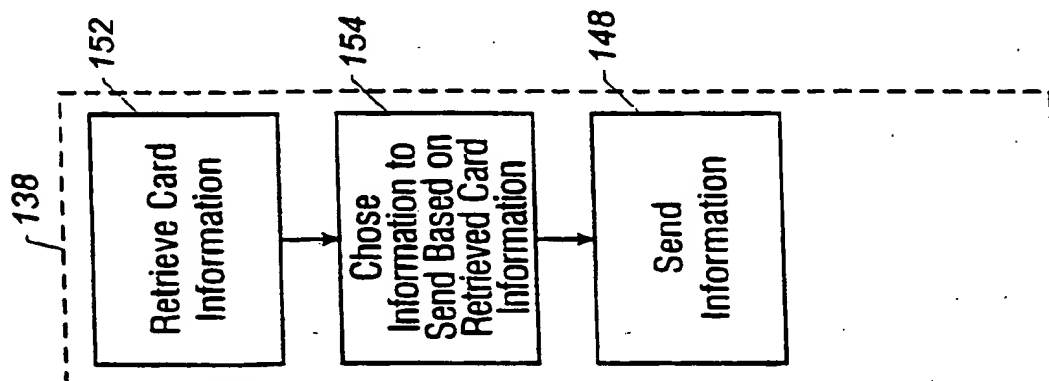


FIG. 14C

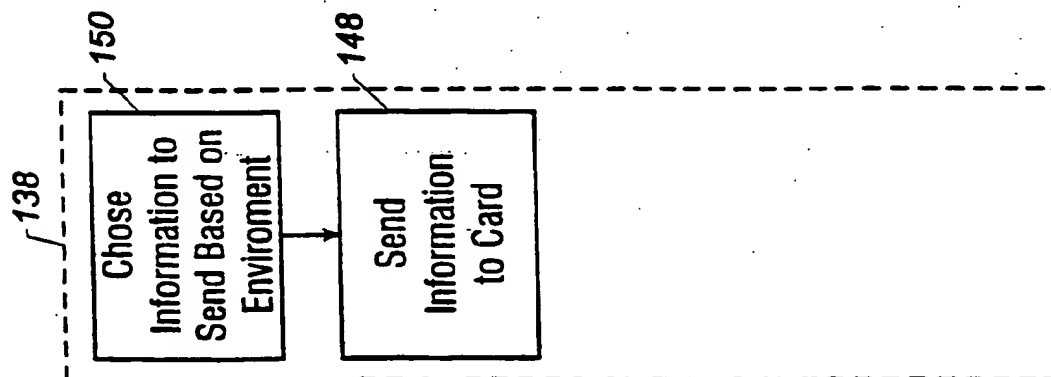


FIG. 14B

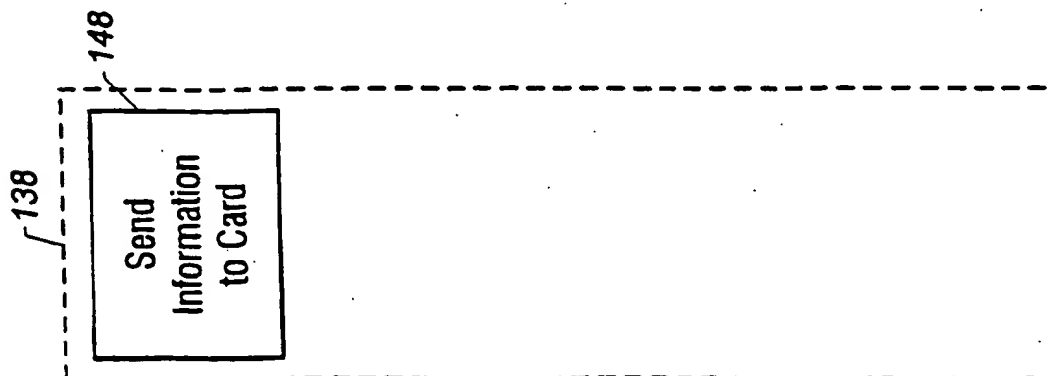


FIG. 14A

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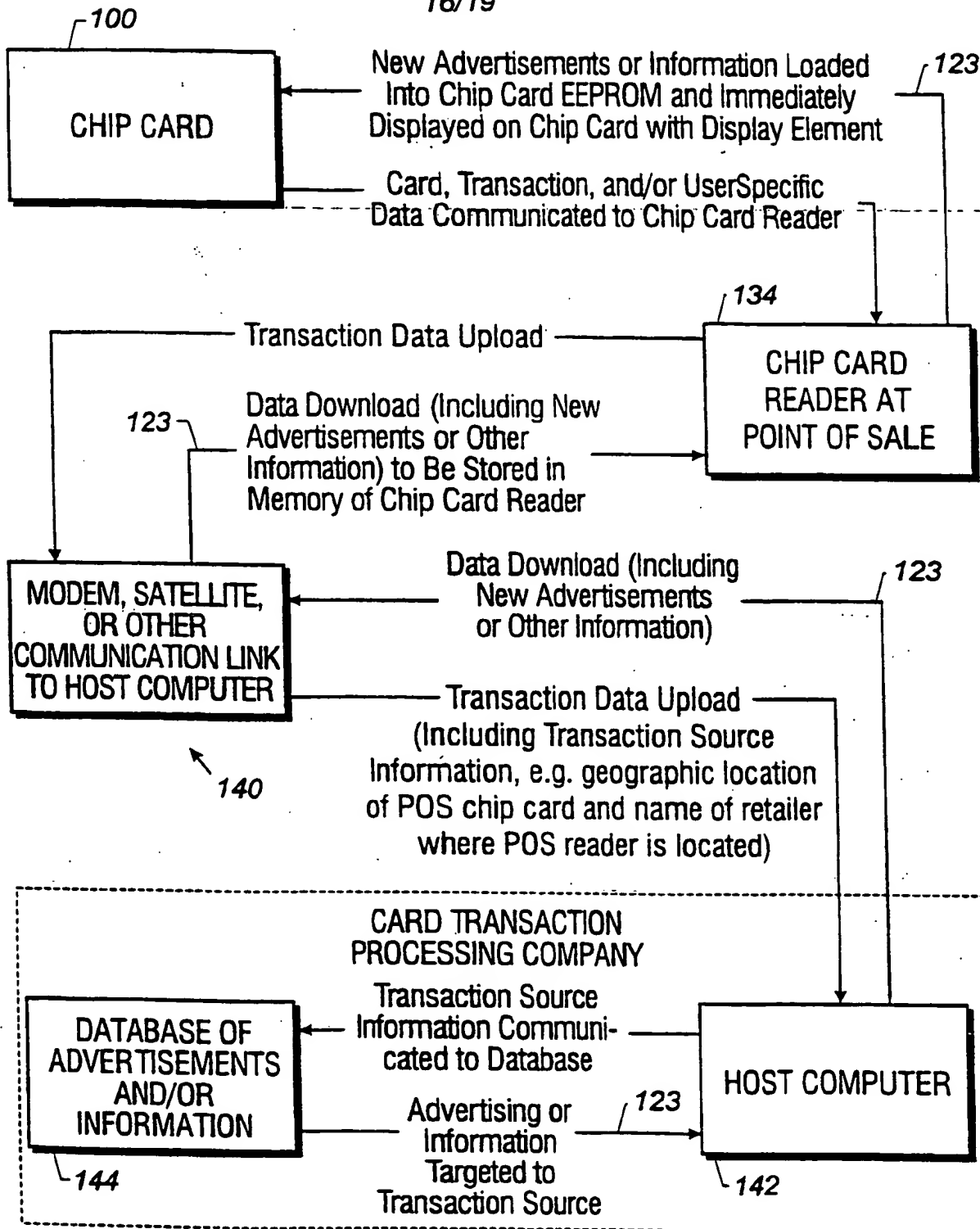
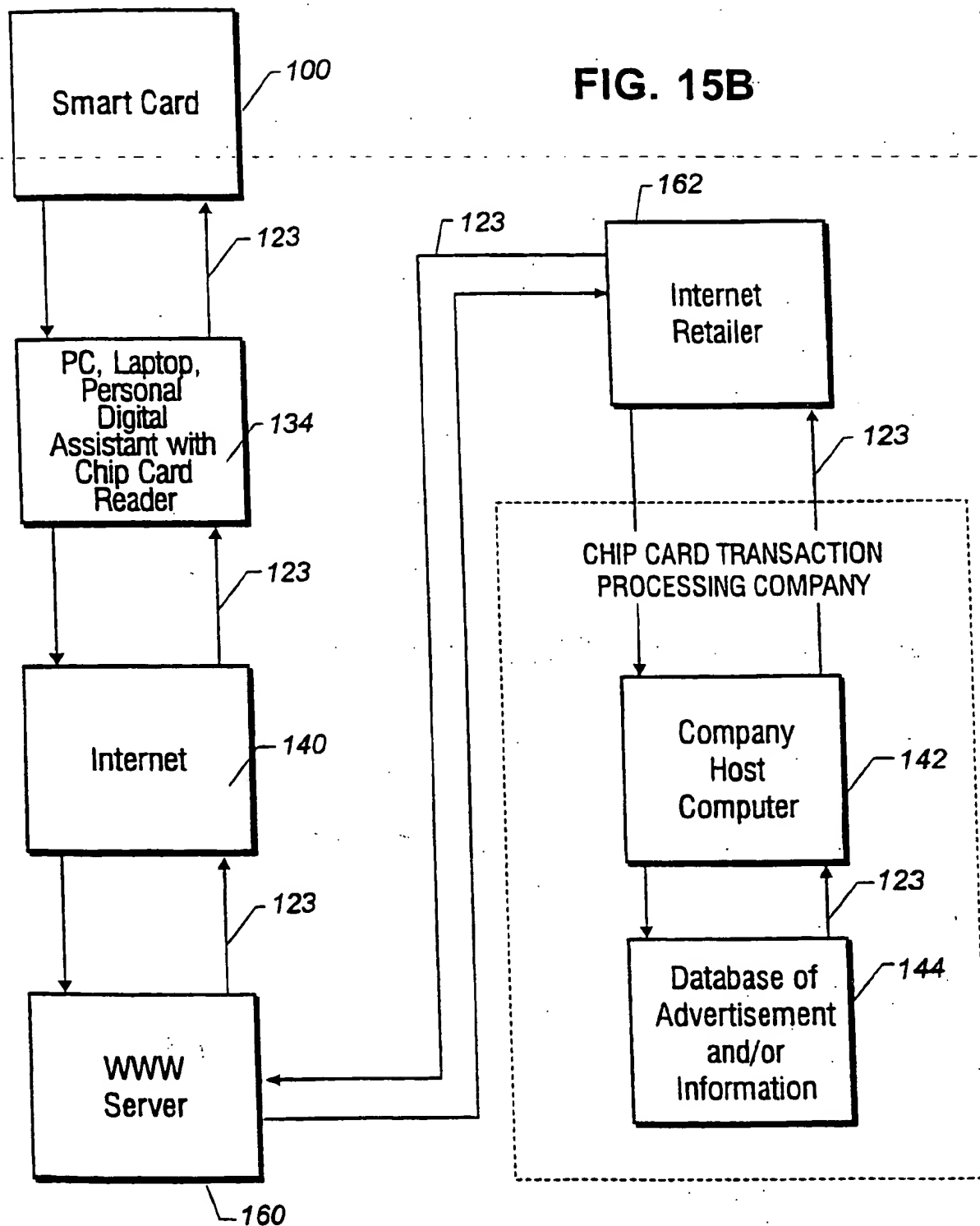


FIG. 15

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FIG. 15B



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FIG. 16A

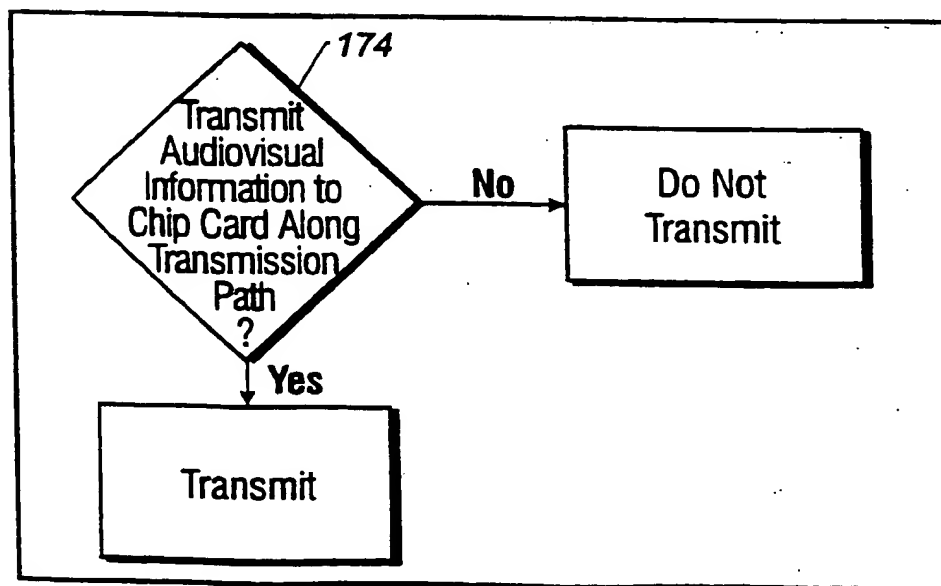
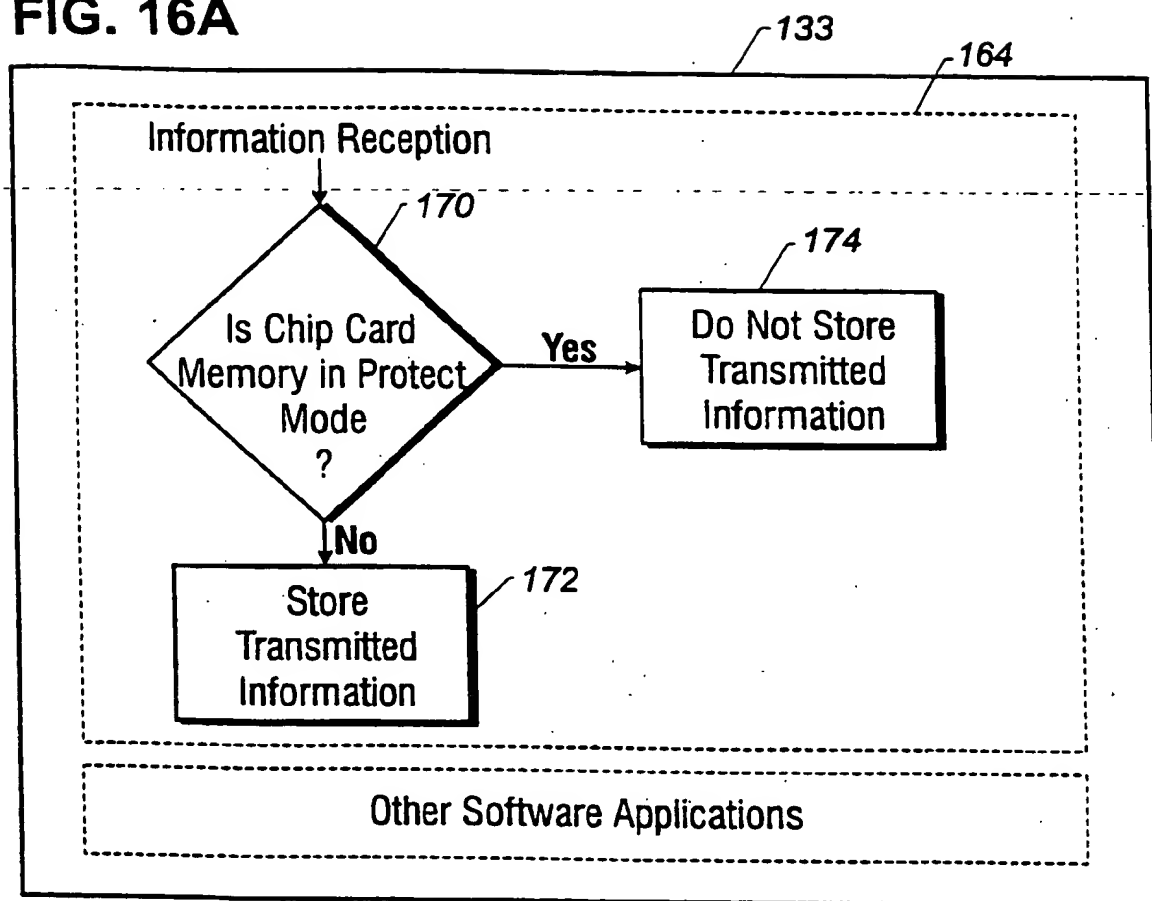
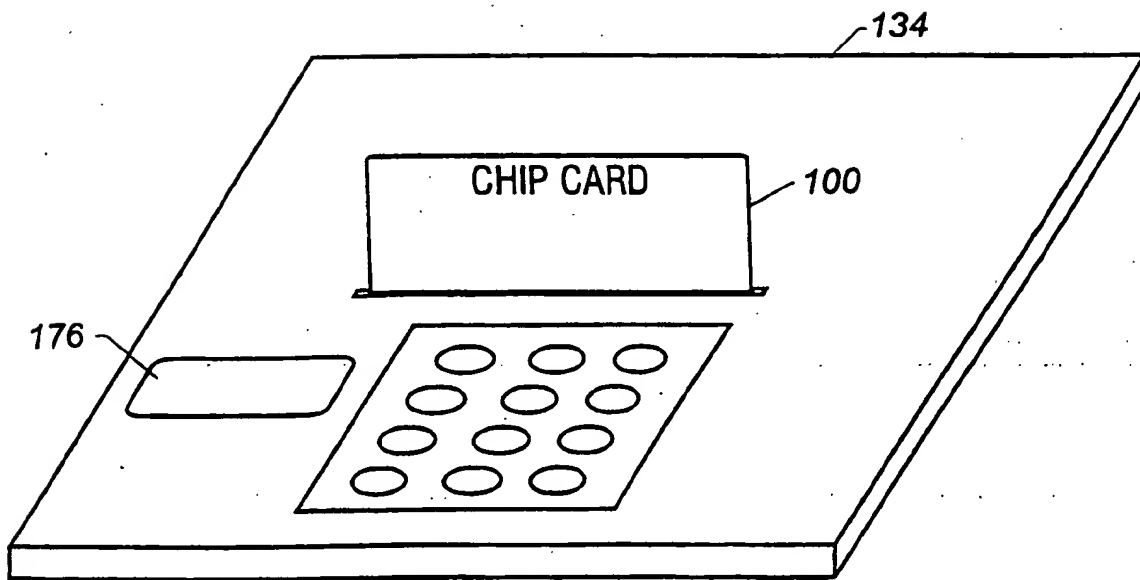
138 or  
146 (FIG. 13)

FIG. 16B

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**FIG. 17**

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US99/01808

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G06K 19/07

US CL : 235/492

According to International Patent Classification (IPC) or to both national classification and IPC.

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 235/492, 375, 380, 382.5; 705/7, 26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

US PTO APS SEARCH TERMS: search terms: advertisement, chip, smart, IC, card, flexible, display, bistable, battery, coupon

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 5,804,803 A (CRAGUN et al.) 08 September 1998 (08.09.98), see abstract.	49
Y	US 5,625,477 A (WU et al.) 29 April 1997 (29.04.97), see abstract.	7, 15, 30



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

26 MARCH 1999

Date of mailing of the international search report

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## INTERNATIONAL SEARCH REPORT

 International application No.  
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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 5,594,493 A (NEMIROFSKY) 14 January 1997 (14.01.97), see columns 9-14.	1, 8-12, 16-23, 28-32, 39-44, 46,50-52, 55-57, 59, and 61-64
		----- 31-32, 33-38, 45, 47-49, 53-54, 58, 60, and 65-66.
Y	US 5,558,957 A (DATTA et al.) 24 September 1996 (24.09.96), see abstract.	7, 15, 30
Y	US 5,315,377 A (ISONO et al.) 24 May 1994 (24.05.94), see abstract.	31-32
Y	US 5,295,064 A (MALEC et al.) 15 March 1994 (15.03.94), see figures 9a and 9b.	45, 47, 48, 53, 60, and 65-66.
Y	US 5,146,068 A (UGAWA et al.) 08 September 1992 (08.09.92), see col. 2, lines 52-69.	59-61
Y	US 4,704,003 A (KOMAKI) 03 November 1987 (03.11.87), see figure 2.	4-6
Y	US 4,677,657 A (NAGATA et al.) 30 June 1987 (30.06.87), see col. 1, lines 35-46.	24-27, 33-38
X,P ----- Y	US 5,777,903 A (POISENKA et al.) 07 July 1998 (07.07.98), see figure 2.	1-4, 8-22, 19, 29 ----- 4-7, 13-17, 21- 27, 33-37.

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